APPENDIX F

Soils Information

The following information and recommendations are from the Soils Section of the Iowa DOT's Office of Design.

A licensed engineer must certify that the bridge berms have been reviewed for long-term stability and provide a minimum slope stability factor of safety of at least 1.3. The engineer should investigate slope stability issues and settlement issues, and provide foundation recommendations or discussions. The engineer should also design any remedial measures that are necessary to address any geotechnical problems.

At least one boring per foundation (i.e. piers and abutments) must be tested by using standard penetration methods so that the 1994 Foundation Soils Information Chart booklet may be used to check foundation type and design. Tables 1.1 and 1.2 from this publication are shown on pages F-3 and F-4 of this appendix. A complete copy of this publication can be obtained by calling the Iowa DOT Office of Design, Soils Design Section, at (515) 239-1026.

Also included in this appendix is a sample Bridge Soil Profile Sheet (see page F-5).

Contact the Iowa DOT Office of Construction for general assistance pertaining to wave equation analysis. Please note however, that the Office of Construction is not available to perform wave equation analysis for city or county projects.

Factors to consider when selecting pile type:

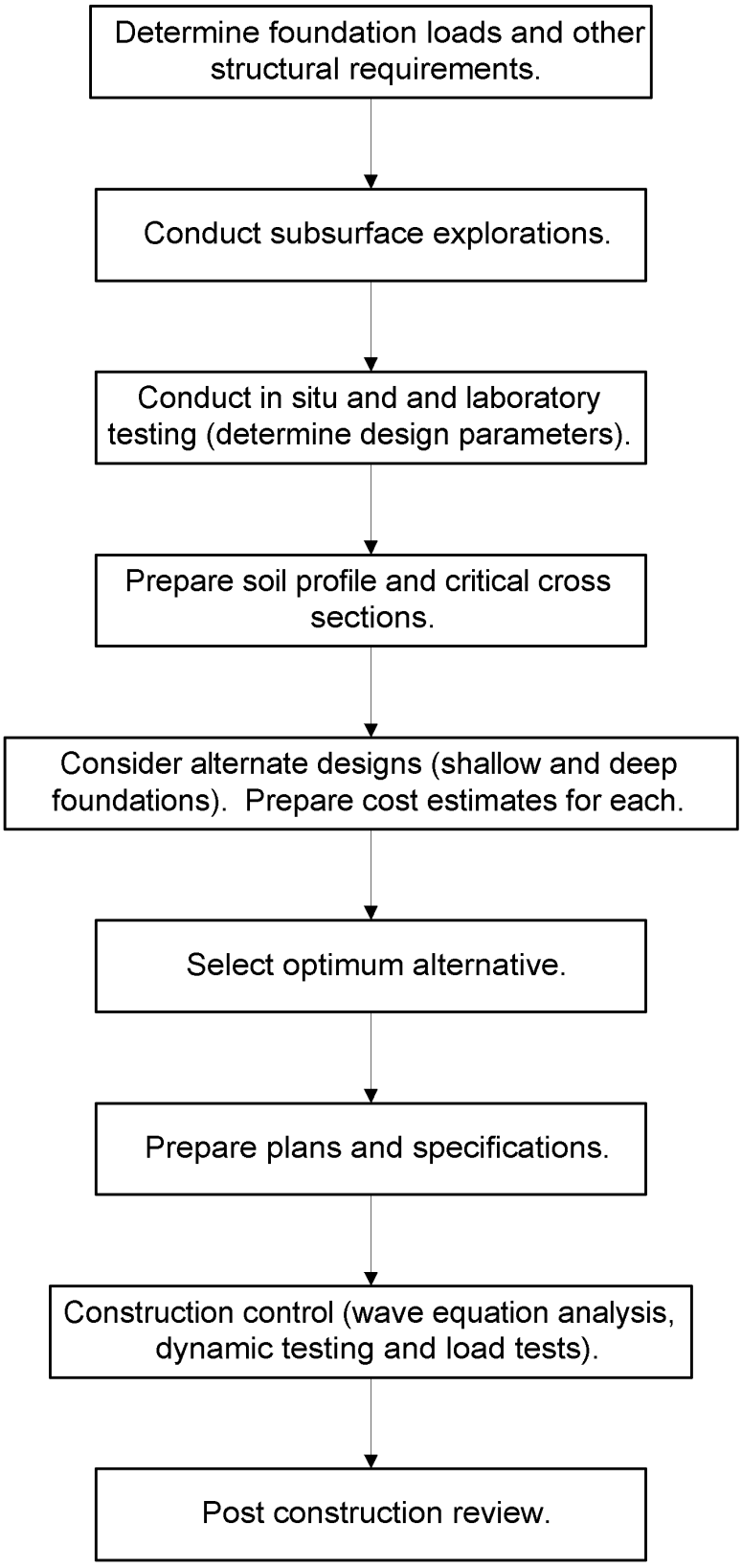
1. Displacement piles may not be drivable in materials having N-values in excess of 25.
2. Displacement piles may not be drivable if identifiable boulder layers are present.
3. Displacement piles may not be drivable through "dry" sands.
4. Steel H piles with driving shoes may be required if sloping bed rock surfaces are to be penetrated.
5. Steel H piles with driving shoes may be required if significant layers of N > 100 are to be penetrated.

Selecting a foundation layer:

1. End all piles in a non-compressible layer.
2. Be sure the required design bearing is obtained below the potential erosion/scour depth.
3. Piles must be well seated in the foundation layer.
4. Minimum pile length in contact with the ground is ten feet.

The flow chart on the following page illustrates the geotechnical foundation investigation, selection and design process for bridges.

FOUNDATION DESIGN PROCESS



DRIVEN PILE FOUNDATION SOILS INFORMATION CHART, ENGLISH UNITS

SOIL DESCRIPTION	BLOW COUNT N - VALUE MEAN	RANGE	ESTIMATED ALLOWABLE END BEARING VALUES IN TONS. Factor of Safety = 2.0 WOOD PILE	STEEL 'H' 10	12	14	CONCRETE 12	14	16	STEEL PIPE PILE 10	12	14	18
GRANULAR MATERIAL	> 10												
Medium Sand	15		8				15	21	27	8	12	16	27
Fine Sand	15		8		*		15	21	27	8	12	16	27
Coarse Sand	20		11				21	29	37	11	16	22	36
Gravelly Sand	21		11				21	29	37	11	16	22	36
	25		14										
		25 - 50		1 000 - 2 000 psi									
		50 - 100		2 000 - 4 000 psi						1.4 x 'N'			
		100 - 300	**	4 000 - 8 000 psi						(tons/sq.ft.)			
		> 300		9 000 psi				**					
Bedrock		100 - 200		6 000 psi									
		> 200		9 000 psi									
COHESIVE MATERIAL													
	12	10 - 50	4				7	10	13	4	6	8	13
	20		6	500 psi			11	16	21	7	9	13	21
	25		8	1 000 psi			15	21	27	8	12	16	27
	50		20	2 000 psi			29	41	53	14	24	32	53
	100		**	3 500 psi					**				

TABLE1.1

NOTE: End Bearing for wood pile is based on the end area = 0.5 sq. ft. Bearing shall be adjusted accordingly for different tip dimension.

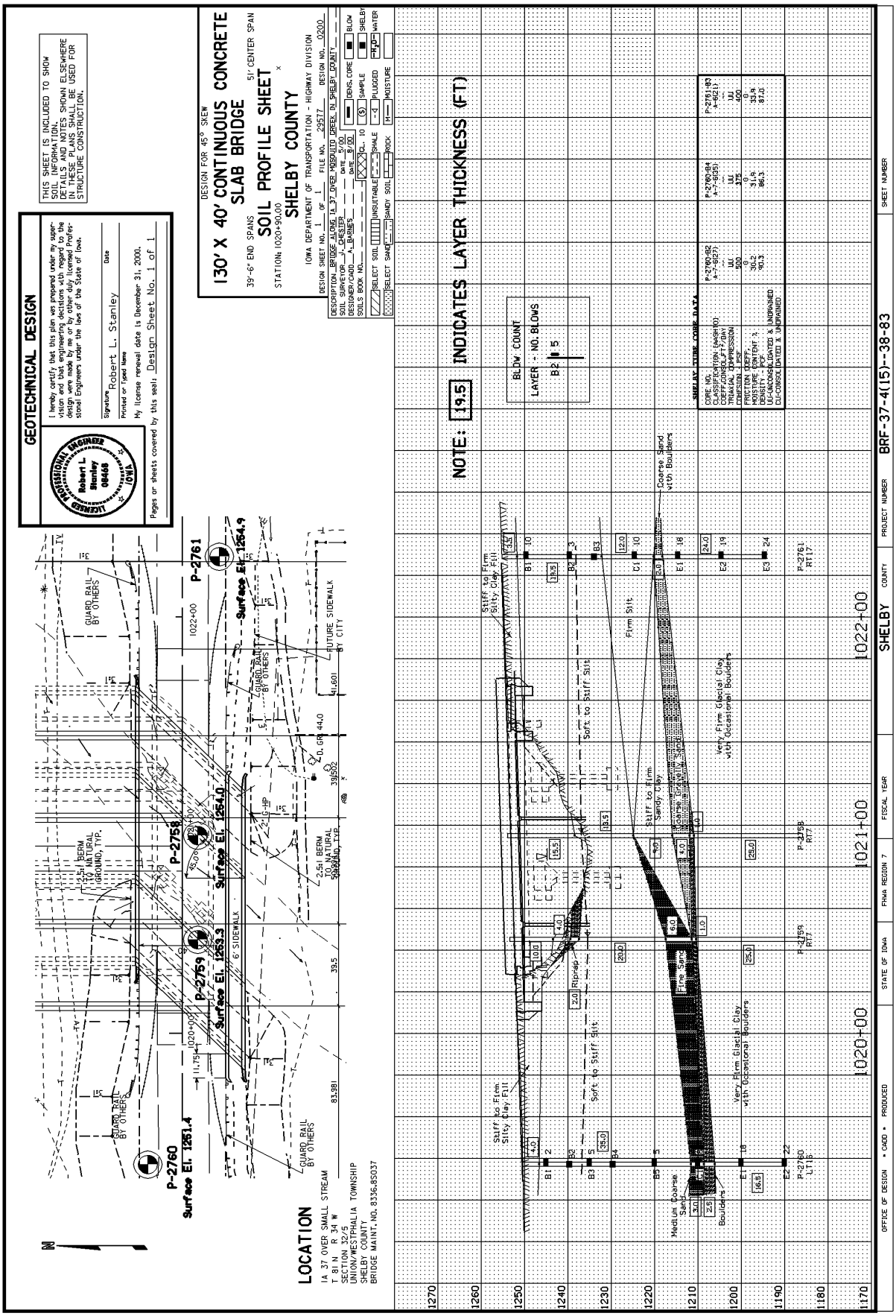
* Do not consider End Bearing in lightly shaded area.
** Usage is NOT recommended in heavy shaded area.

PILE SIZE	'H' PILE END AREA IN SQUARE INCHES
10X42	12.4
10X57	16.8
12X53	15.5
12X74	21.8
14X72	21.4
14X89	26.1

DRIVEN PILE FOUNDATION SOILS INFORMATION CHART, ENGLISH UNITS													
	BLOW COUNT		ESTIMATED ALLOWABLE BEARING VALUES FOR FRICTION PILE IN T/FT. Factor of Safety = 2.0										
	N - VALUE		WOOD	STEEL "H"			CONCRETE			STEEL PIPE PILE			
SOIL DESCRIPTION	MEAN	RANGE	PILE	10	12	14	12	14	16	10	12	14	18
ALLUVIUM or LOESS													
Very Soft Silty Clay	1	0 - 1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2
Soft Silty Clay	3	2 - 4	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Stiff Silty Clay	6	4 - 8	0.4	0.3	0.4	0.5	0.3	0.4	0.5	0.3	0.3	0.4	0.5
Firm Silty Clay	11	7 - 15	0.6	0.5	0.6	0.7	0.6	0.7	0.8	0.4	0.5	0.6	0.7
Stiff Silt	6	3 - 7	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4
Stiff Sandy Silt	6	4 - 8	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.4
Stiff Sandy Clay	6	4 - 8	0.4	0.3	0.4	0.5	0.5	0.5	0.6	0.3	0.4	0.4	0.5
Silty Sand	8	3 - 13	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.2	0.2	0.3	0.4
Clayey Sand	13	6 - 20	0.5	0.4	0.5	0.7	0.6	0.6	0.7	0.4	0.5	0.6	0.7
Fine Sand	15	8 - 22	0.6	0.5	0.6	0.7	0.6	0.7	0.8	0.4	0.5	0.6	0.7
Coarse Sand	20	12 - 28	0.8	0.7	0.8	0.9	0.8	0.9	1.0	0.5	0.6	0.7	0.9
Gravelly Sand	21	11 - 31	0.8	0.7	0.8	0.9	0.9	0.9	1.0	0.5	0.6	0.7	0.9
Granular Material	>40		1.0	1.0	1.2	1.4				0.8	1.0	1.1	1.4
GLACIAL CLAY													
Firm Silty Glacial Clay	11	7 - 15	0.7	0.6	0.7	0.8	0.7	0.8	0.9	0.5	0.6	0.6	0.8
Firm Clay (Gumbotil)	12	9 - 15	0.7	0.6	0.7	0.8	0.7	0.8	0.9	0.5	0.6	0.6	0.8
Firm Glacial Clay	11	7 - 15	0.6	0.7	0.8	0.9	0.8	0.9	1.0	0.5	0.6	0.7	0.9
			(0.8)	(0.8)	(1.0)	(1.1)	(1.0)	(1.1)	(1.2)	(0.6)	(0.7)	(0.8)	(1.1)
Firm Sandy Glacial Clay	13	9 - 15	0.6	0.7	0.8	0.9	0.8	0.9	1.0	0.5	0.6	0.7	0.9
			(0.8)	(0.8)	(1.0)	(1.1)	(1.0)	(1.1)	(1.2)	(0.6)	(0.7)	(0.8)	(1.1)
Firm - Very Firm Gl. Clay	14	11 - 17	0.7	0.7	0.8	0.9	1.0	1.1	1.2	0.6	0.7	0.8	1.0
			(0.9)	(1.0)	(1.2)	(1.4)	(1.2)	(1.3)	(1.4)	(0.8)	(0.9)	(1.0)	(1.3)
Very Firm Glacial Clay	24	17 - 30	0.7	0.7	0.8	0.9	0.8	0.9	1.1	0.6	0.7	0.8	1.0
			(0.9)	(1.0)	(1.2)	(1.4)	(1.2)	(1.4)	(1.6)	(0.8)	(0.9)	(1.0)	(1.3)
Very Firm Sandy Gl. Clay	25	15 - 30	0.8	0.7	0.8	0.9	0.8	0.9	1.1	0.6	0.7	0.8	1.0
			(1.0)	(1.0)	(1.2)	(1.4)	(1.2)	(1.4)	(1.6)	(0.8)	(0.9)	(1.0)	(1.3)
Cohesive or Glacial Material	>35		0.8	0.7	0.8	0.9	0.8	0.9	1.1	0.5	0.6	0.7	0.9
			(1.0)	(1.0)	(1.2)	(1.4)	(1.2)	(1.4)	(1.6)	(0.8)	(1.0)	(1.1)	(1.4)

TABLE 1.2

For Double Entries:
Upper Value is designated for an embedded pile within 30' of the natural ground elevation.
Lower Value is designated for pile depths more than 30' below the natural ground elevation.



SAMPLE BRIDGE SOIL PROFILE SHEET